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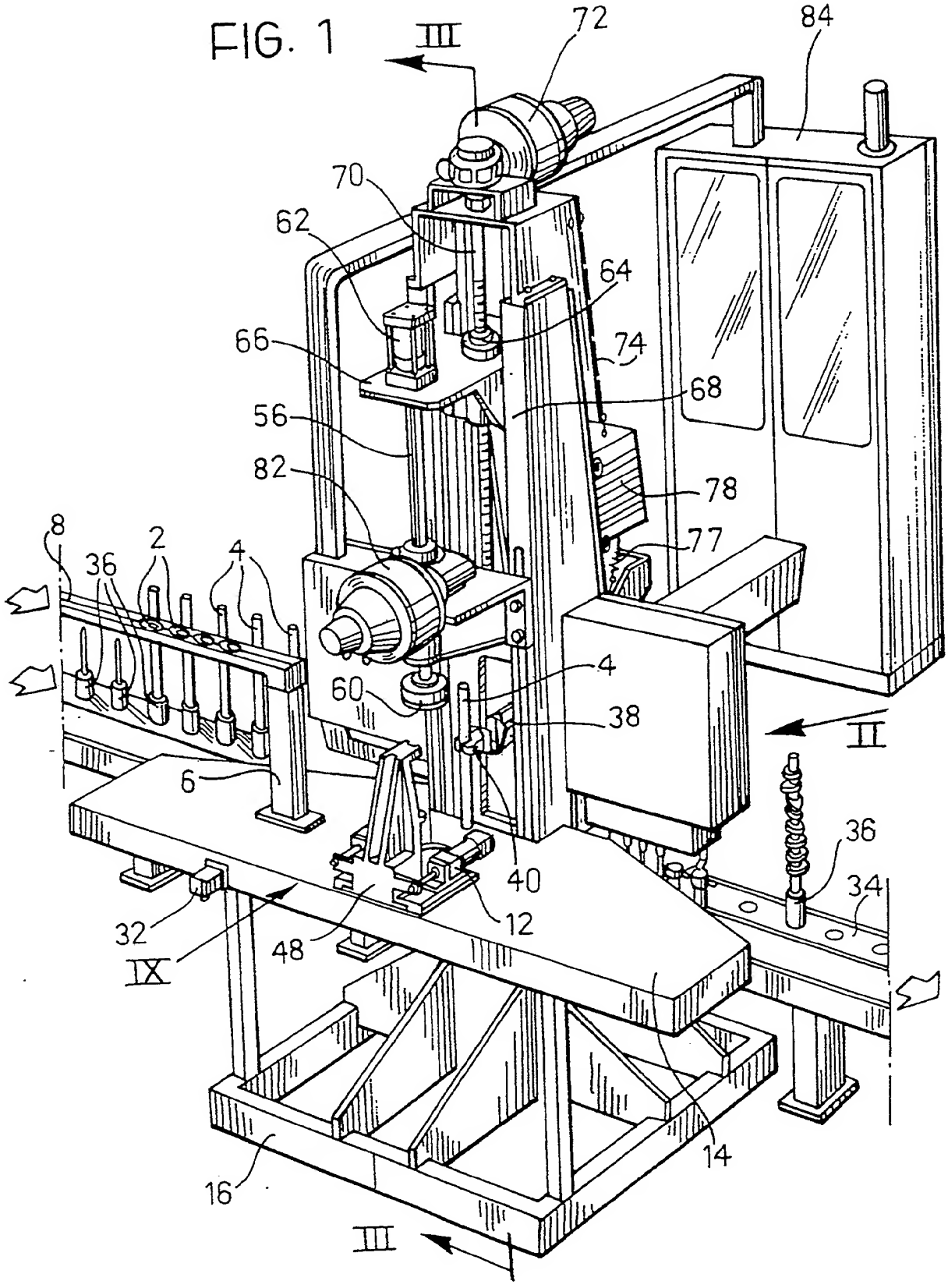
(54) An automatic machine for force-fitting drilled, shaped elements onto a shaft.

(57) The machine, which is particularly suitable for fitting cams (2) onto a camshaft (4) for an internal combustion engine, comprises means (10, 26) for successively supplying the cams (2) and positioning them in an assembly seat (12) whose wall (20) which is intended to face the hole (24) in the cam (2) has a hole (22) with which the hole (24) is arranged coaxially, and means (34, 38, 48) for offering up the shaft (4) and positioning it on a working axis (58) which coincides with the axis of the hole (24) in the cam (2) positoned in the assembly seat (2). The machine also includes means (56) for moving the shaft which is positioned on the working axis (58) along that axis so as to force-fit the cam (2) on the shaft (4) when the latter enters the holes (22, 24) in the cam (2) and the assembly seat (12), and means (38) for removing the shaft (4) on which one or more cams (2) have been force-fitted.

EP 0 462 081 A1

FIG. 1


III
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IX
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16
III

The present invention relates to an automatic machine for force-fitting drilled, shaped elements, particularly cams, onto a shaft which is intended, in particular, to become the camshaft of an internal combustion engine.

The object of the present invention is to provide a machine of the type indicated above whose operation is simple and reliable and which can force-fit shaped and drilled elements onto their shaft automatically and under cold conditions.

The subject of the present invention is an automatic machine of the type indicated above, characterised in that it comprises:
means for successively supplying the cams and positioning them in an assembly seat whose wall which is intended to face the hole in the cam has a hole with which the hole in the cam is arranged coaxially,
means for offering up the shaft and positioning it on a working axis which coincides with the axis of the hole in the cam positioned in the assembly seat,
means for moving the shaft which is positioned on the working axis along that axis so that the cam is force-fitted onto the shaft when the latter enters the coaxial holes in the cam and the assembly seat, and
means for removing the shaft on which one or more cams have been force-fitted.

A further subject of the present invention is a method for force-fitting drilled, shaped elements, particularly cams, onto a shaft which is intended, in particular, to become the camshaft of an internal combustion engine, the method being characterised in that it provides for the use of an automatic machine of the type described above.

The machine according to the invention has the advantage that it does not need expensive and complex heating devices for shrink-fitting the cams onto their shafts.

Further advantages and characteristics of the present invention will become clear from the detailed description which follows, with reference to the appended drawings, provided purely by way of non-limiting example, in which:

Figure 1 is a perspective view of a machine according to the invention, from the front,

Figure 2 is a perspective view of the machine of Figure 1, from the rear,

Figure 3 is a section taken on the line III-III of Figure 1,

Figures 4 to 8 show schematically a detail of the machine of the preceding drawings in different operating positions,

Figure 9 shows, in perspective, another detail of the machine, indicated by the arrow IX in Figure 1,

Figure 10 shows a further detail of the machine, indicated by the arrow X in Figure 9,

Figures 11 and 12 are sections of a mechanism of the machine, taken on the line XI-XI of Figure 9 in two different operating conditions, and

Figure 13 is a perspective view of a further detail of the machine.

An automatic machine (Figure 1) for force-fitting cams 2 onto a respective shaft 4 which is intended to become the camshaft of an internal combustion engine includes a magazine 6 in which the cams 2, supplied by a conveyor belt 8, are stacked one upon another. The bottom cam 2a of the stack in the magazine 6 (Figures 9 to 12) is arranged in a supply channel 10 which leads to an assembly seat 12. The seat 12, which is positioned on a work table 14 supported by a support structure 16 (Figure 1), has a shaped side wall 18 (Figure 9) whose profile corresponds to that of the facing portions of the cams 2 and is open on one side to enable their insertion, as will be described in further detail below. The assembly seat 12 also has a base wall 20 with a hole 22 of a larger diameter than the holes 24 in the cams 2.

A slider 26 driven by actuator means 27 of known type is movable in the supply channel 10, its front portion 28 (Figure 10) being shaped to correspond with the profile of the facing portion of the cam 2.

A photoelectric safety device 32 of known type is located adjacent a slot 30 in the wall of the channel 10 in the region in which the bottom cam 2a is housed to indicate the presence of the cam 2a.

The machine also includes (Figures 2, 3 and 13) a conveyor belt 34 from the top of which project a plurality of support rods 36 on each of which is fitted a respective hollow shaft 4 whose outside diameter is slightly larger than the diameters of the holes 24 in the cams 2. An operator arm 38 is mounted near the conveyor belt 34 and its end facing the conveyor belt 34 supports a gripper 40 for gripping the shafts 4 with actuator means of known type. The arm 38 is movable by actuator means 42 of known type, both along a first line parallel to the support rods 36, indicated by the arrows 44 in Figure 13, and along a second line, indicated by the arrows 46 in Figure 13, which is perpendicular to the general plane defined by the conveyor belt 34 and the shafts 4 fitted on the support rods 36.

An abutment bracket 48 (Figures 1 to 3) is movable on the work table 14, along the line indicated by the arrows 46, under the action of known actuator means 49. The bracket 48 faces the gripper 40 of the operator arm 38 and, when the machine is in the rest condition, is arranged on the opposite side of the conveyor belt 34 and the assembly seat 12 for the cams 2 from the operator arm 38. The bracket 48 includes a vertical element 50 from which several spaced-apart horizontal elements 52 project, each having a recess 54 for supporting the shaft 4 as will become clearer from the following operational description.

The machine also includes a chuck 56 (Figures 1 to 3) mounted vertically on the axis 58 (Figure 3) which is defined by the hole 22 in the assembly seat 12 and will hereinafter be termed the working axis.

The end of the chuck 56 which faces the assembly seat 12 has jaws 60 operated by known actuator means 62 for ,ripping the end of a shaft 4, as will be described below. A nut 64 connected to the chuck 56 by a plate 66 is mounted, between guide pillars 68 fixed to the support structure 16 on a lead screw 70 rotatable by a geared motor unit 72. In this way the chuck 56 can translate along the working axis 53 as a consequence of the activation of the geared motor unit 72. The nut 64 is also connected to a counterweight mechanism for regulating the movement of the chuck 56 (Figures 2 and 3). This mechanism comprises a pair of cables 74 passing around respective pairs of pulleys 76 which are freely rotatable on the support structure 16 and define two substantially vertical portions 74a and 74b of each cable 74, one of which is connected to the plate 66 and the other of which incorporates a spring 77 and a weighted trolley 78 slidable on rails 80 inclined to the vertical and fixed to the support structure 16.

A further geared motor unit 82 enables the chuck 56 to rotate about its own axis.

The various parts of the machine described hitherto are controlled by a central computer 84 (Figure 1) which regulates the operation of the machine, stopping it, for example, when the photoelectric device 32 indicates that there are no cams 2 in the supply channel 10.

When the machine is in operation, the slider 26 (Figures 9 and 11) slides in the channel 10 and inserts the bottom cam 2 from the magazine 6 in the assembly seat 12 so that the hole 24 in the cam 2 is aligned on the working axis 58, the slider 26 simultaneously acting as a support for the stack of cams 2 still in the magazine 6.

At the same time, the operator arm 38 is translated along the line indicated by the arrows 46 (Figure 13), the gripper 40 grips a shaft 4 supported by a rod 36, and the arm 38 rises along the line indicated by the arrows 44, thus releasing the shaft 4 from the rod 36. The arm is then lowered and translated, again along the line indicated by the arrows 46, to bring the shaft 4 into contact with the abutment bracket 48 (Figure 4). This now moves, still along the line indicated by the arrows 46 but in the opposite direction (Figure 5), pushing the shaft 4 supported by the gripper 40 until it is aligned on the working axis 58. At this point, after it has been lowered (Figure 6), the chuck 56 grips the upper end of the shaft 4 with its jaws 60, whilst the operator arm 38 and the bracket 48 return to their starting positions.

The chuck 56 is then lowered further (Figure 7) to insert the shaft 4 in the hole 24 in the cam 2 positioned in the assembly seat 12 and in the hole 22 in the seat 12. The cam 2 is thus fixed to the shaft 4 as a result of the interference between the shaft and the hole 24 in the cam 2. Finally (Figure 8), the shaft 4 is raised by the chuck 56 and the assembly seat 12 is thus ready to receive another cam 2.

The slider 26 (Figure 12) now slides back along the supply channel 10 and, as it passes the portion opposite the magazine 6, causes the new bottom cam 2a to fall into the channel 10 for insertion in the assembly seat 12 during the subsequent advance of the slider 26. The chuck 56 is then lowered and raised again, force-fitting a new cam 2 on the shaft 4.

Clearly, this cycle of operations is repeated for a number of times equal to the number of cams to be fitted on the shaft 4. If the cams are to be arranged in different orientations, the geared motor unit 82 rotates the chuck 56, and hence the shaft 4, during the interval between the insertion of two successive cams in the assembly seat 12.

When the cams 2 have been fitted on the shaft 4, the gripper 40 carried by the operator arm 38 again grips the shaft 4 which is released by the jaw 60 of the chuck 56. The arm 38 is then retracted along the line indicated by the arrows 46 and moves along the line indicated by the arrows 44 (Figure 13) to replace the camshaft produced on a support rod 36 of the conveyor be it 34.

Naturally, the principle of the invention remaining the same, the details of construction and forms of embodiment may be varied widely with respect to those described and illustrated purely by way of example, without thereby departing from its scope.

Claims

1. An automatic machine for force-fitting drilled,shaped elements, particularly cams (2), onto a shaft (4) which is intended, in particular, to become the camshaft of an internal combustion engine, characterised in that it comprises:
   means (6, 10, 25) for successively supplying the cams (2) and positioning them in an assembly seat (12) whose wall (20) which is intended to face the hole (24) in the cam (2) has a hole (22) with which the hole (24) in the cam (2) is arranged coaxially,
   means (34, 38, 48) for offering up the shaft (4) and positioning it on a working axis (58) which coincides with the axis of the hole (22) in the assembly seat (12),
   means (56) for moving the shaft (4) which is positioned on the working axis (58) along that axis so that the cam (2) is force-fitted onto the shaft (4) when the latter enters the coaxial holes (22, 24) in the cam (2) and the assembly seat (12), and
   means (34, 38) for removing the shaft (4) on which one or more cams (2) have been force-fitted.

2. An automatic machine according to Claim 1, characterised in that the assembly seat (12)

includes a shaped side wall (18) with a profile which corresponds to that of the facing portion of the cam (2) and a portion which is open to enable the insertion of the cam (2) .

3. An automatic machine according to any one of the preceding claims, characterised in that the means for supplying and positioning the cams (2) comprise:
a magazine (6) in which the cams (2) are stacked one upon another,
a supply channel (10) which leads to the assembly seat (12) and in which the bottom cam (2a) of the stack of cams housed in the magazine (6) is positioned, and
a slider (26) which is movable in the channel (10) under the action of actuator means (27) and which, when it slides in one direction, pushes the bottom cam (2a) towards the assembly seat (12), simultaneously acting as a support for the stack of cams (2) housed in the magazine, and, when it slides in the opposite direction, enables a further cam (2) to fall into the channel (10).

4. An automatic machine according to Claim 3, characterised in that it includes a photoelectric device (32) adjacent a slot (30) in the wall of the channel (10) in the region in which the bottom cam (2a) is housed for indicating the presence of the bottom cam (2a).

5. An automatic machine according to Claim 3, characterised in that the front portion (28) of the slider (26) which is intended to push the cam (2a) towards the assembly seat (12) corresponds in shape to the facing portion of the cam (2a).

6. An automatic machine according to any one of the preceding claims, characterised in that the means for offering up, positioning and removing the shaft (4) comprise:
a conveyor belt (34) from the top of which projects a plurality of support rods (36) on each of which a respective shaft (4) is fitted,
an operator arm (38) one end of which faces the conveyor belt (34) and supports a gripper (40) for gripping the shafts (4), the arm being movable under the action of actuator means (42) both along a first line (44) parallel to the support rods (36) and along a second line (46) perpendicular to the general plane defined by the shafts (4) fitted on the respective support rods (36), and
an abutment bracket (48) which faces the gripper (40) on the opposite side of the conveyor belt (34) and the assembly seat (12) for the cams (2) when the machine is inoperative, and is movable under the action of actuator means (49) along the second line (46); during the positioning of a shaft (4) after it has been gripped by the gripper (40), the operator arm (38) is first raised along the first line (44) to remove the shaft (4) from the support rod (36) and is then translated along the said line (46) towards the abutment bracket (48) with which the shaft (4) comes into contact, the bracket (48) then moving in turn in the opposite direction along the second line (46) until the shaft (4), still supported by the gripper (40), is aligned on the working axis (58).

7. An automatic machine according to Claim 6, characterised in that the abutment bracket (48) includes a vertical element (50) from which several spaced-apart horizontal elements (52) project, each having a recess (54) for supporting the shaft (4).

8. An automatic machine according to any one of the preceding claims, characterised in that the means for moving the shaft (4) comprise a chuck (56) which is mounted vertically on the working axis (58), has means (64, 70, 72) for sliding it along the working axis (58) and, on its end which faces the assembly seat (12), has jaws (60) operated by actuator means (62) for gripping the shaft (4) which has been positioned on the working axis (58) by the positioning means (38, 48).

9. An automatic machine according to Claim 8, characterised in that the means for sliding the chuck (56) along the working axis (58) comprise a nut (64) which is connected rigidly to the chuck (56) by means of a plate (66) arranged between guide pillars (68) fixed to a support structure (16), and which is mounted on a lead screw (70) rotatable by a geared motor unit (72).

10. An automatic machine according to Claim 9, characterised in that the nut (64) is connected to a counterweight mechanism for regulating the movement of the chuck (56), the mechanism comprising a pair of cables (74) which pass around respective pairs of pulleys (76) freely rotatable on the support structure (16), the pulleys (76) defining two substantially vertical portions (74a, 74b) of each cable (74), one of which is connected to the plate (66) and the other of which incorporates a spring (77) and a ballasted trolley (78) slidable on rails (80) fixed to the support structure (16) and inclined to the vertical.

11. An automatic machine according to any one of Claims 8 to 10, characterised in that the chuck (56) has drive means, such as a geared motor unit (82), for rotating the chuck (56) about its own axis so that several cams (2) fitted in succession on the shaft (4) supported by the chuck (56) can

be oriented differently.

12. A method for force-fitting drilled, shaped elements, particularly cams (2), on a shaft (4) which is intended, in particular, to become the camshaft of an internal combustion engine, the method being characterised in that it provides for the use of a machine according to any one of the preceding claims.

FIG. 1

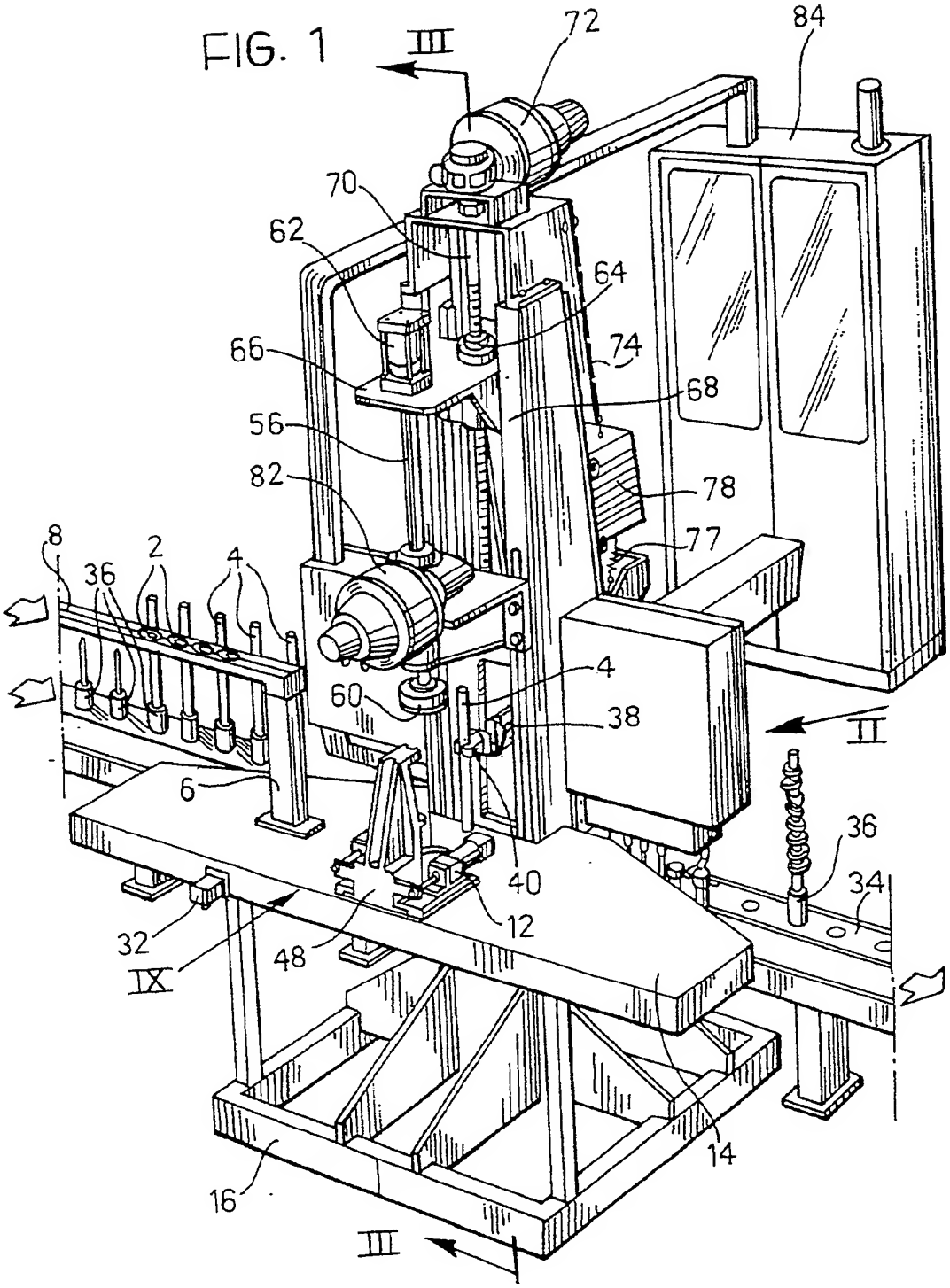
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FIG. 2

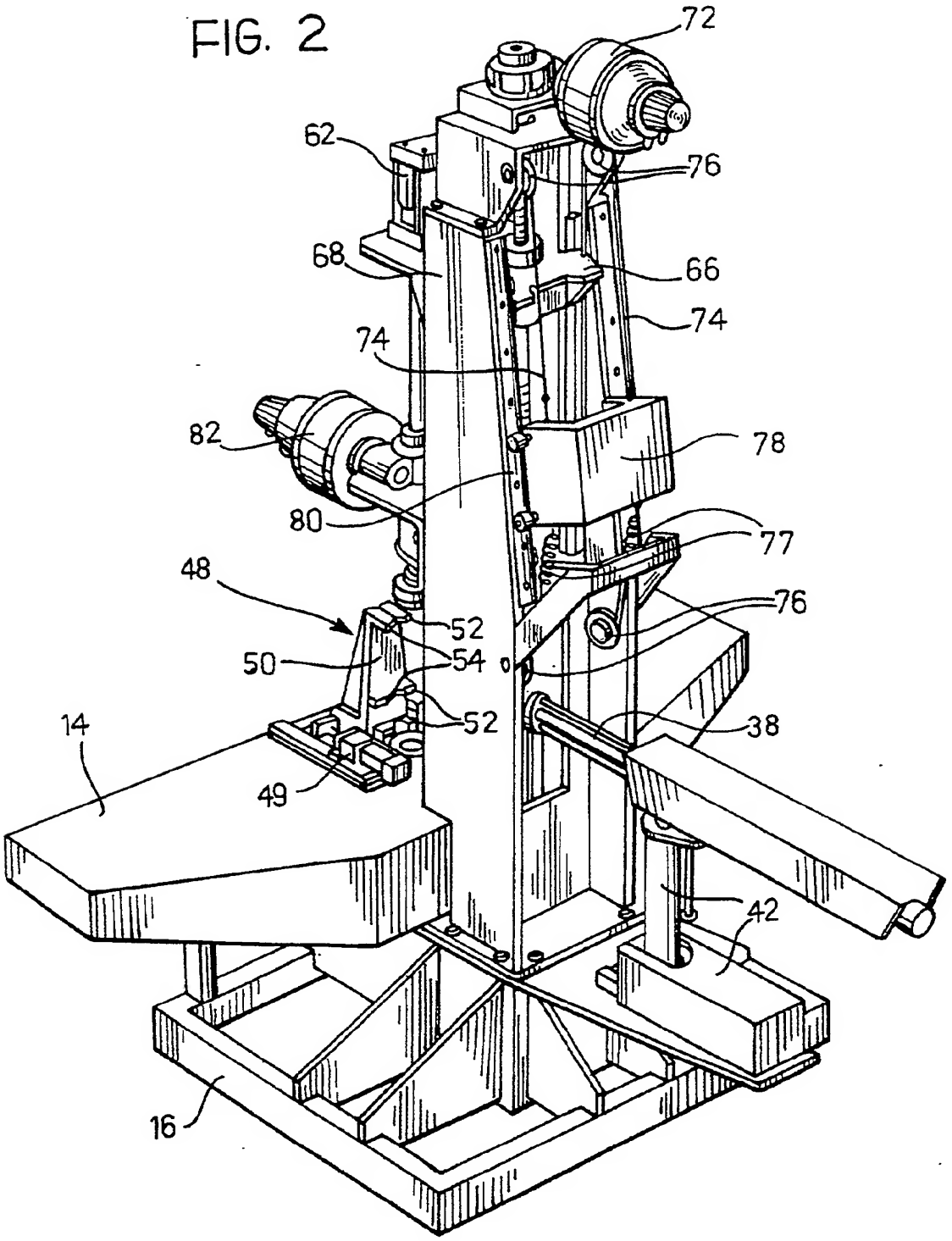
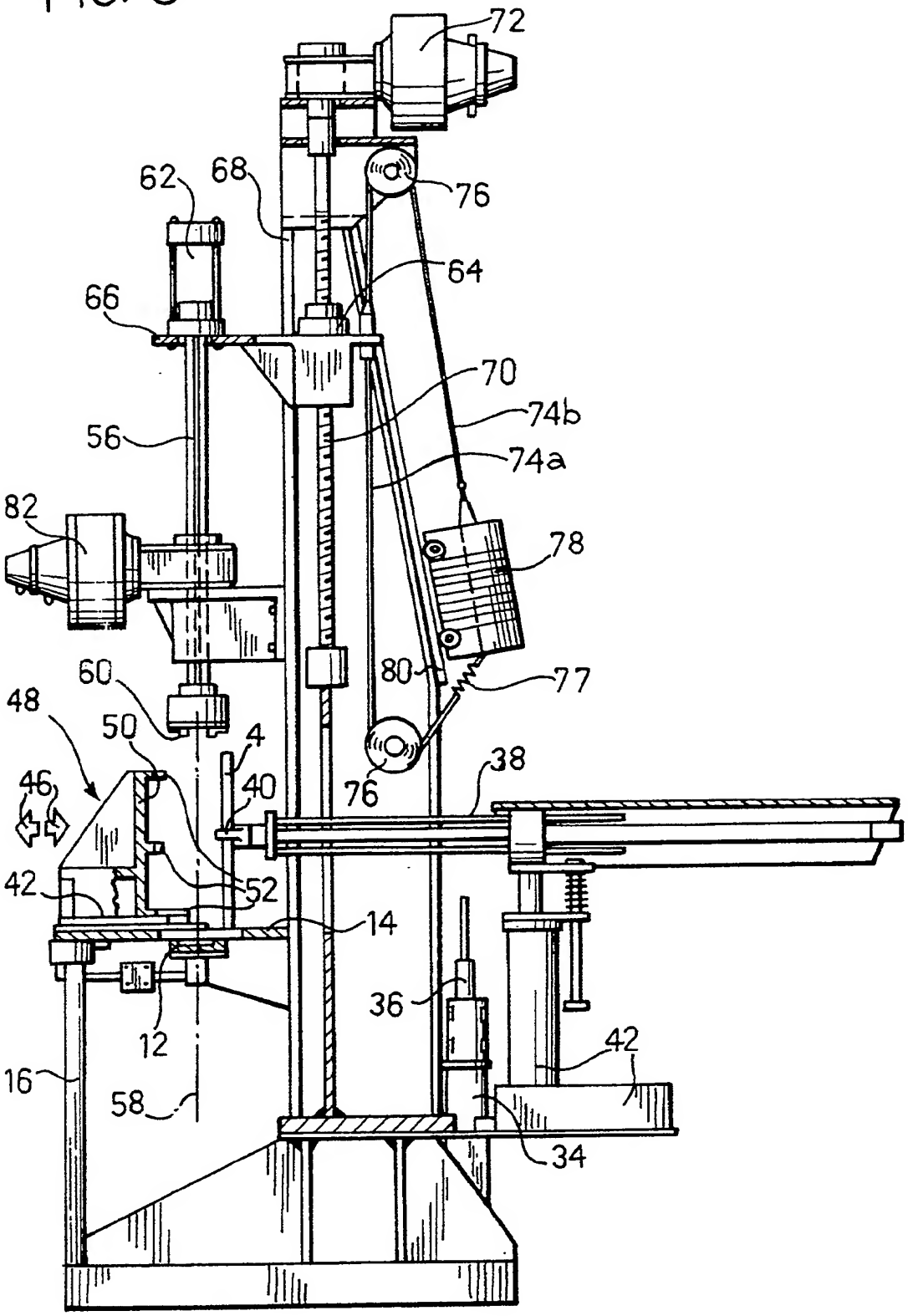


FIG. 3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74a
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FIG. 4

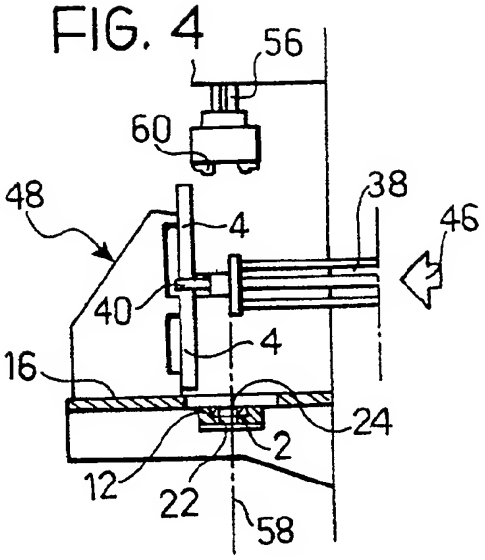


FIG. 5

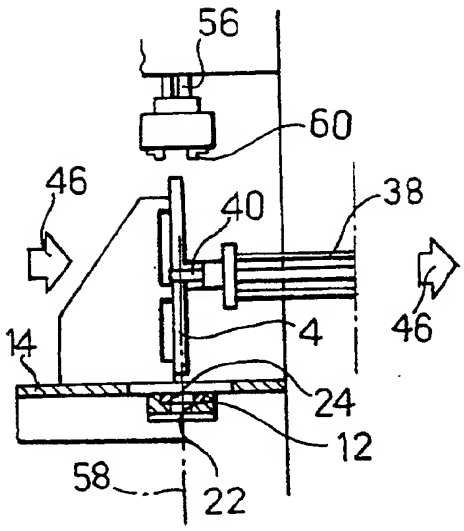


FIG. 6

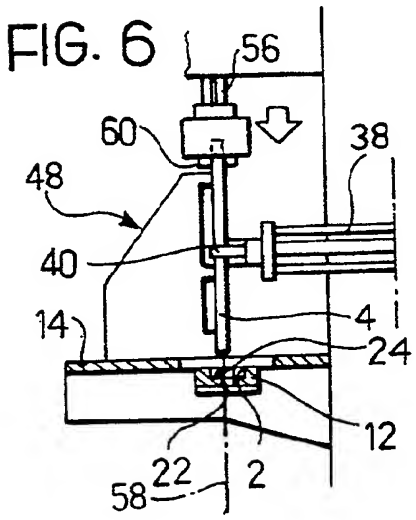


FIG. 7

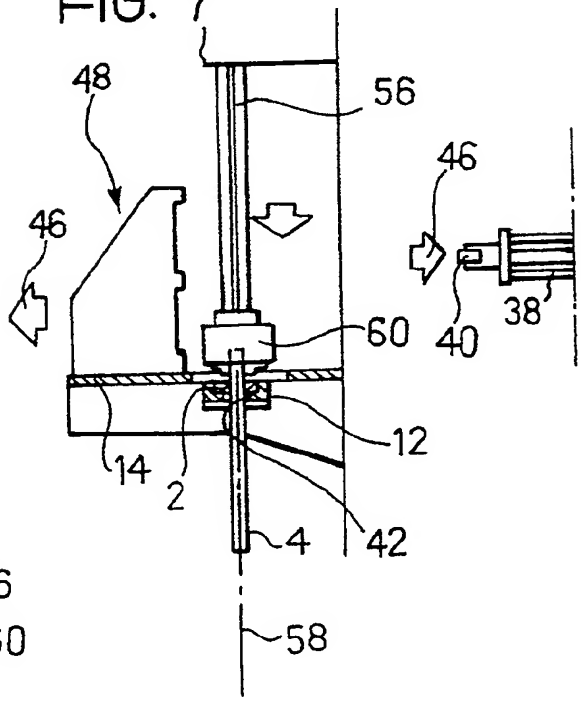


FIG. 8

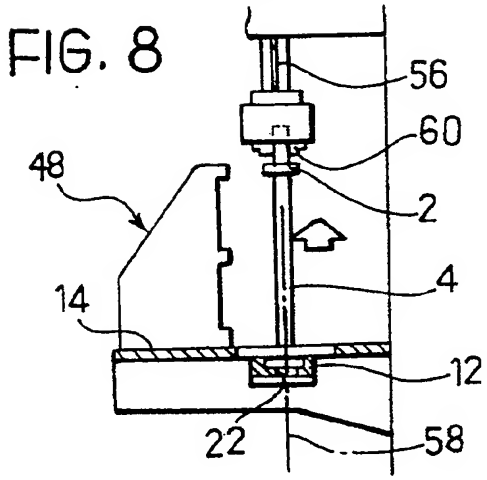


FIG. 9

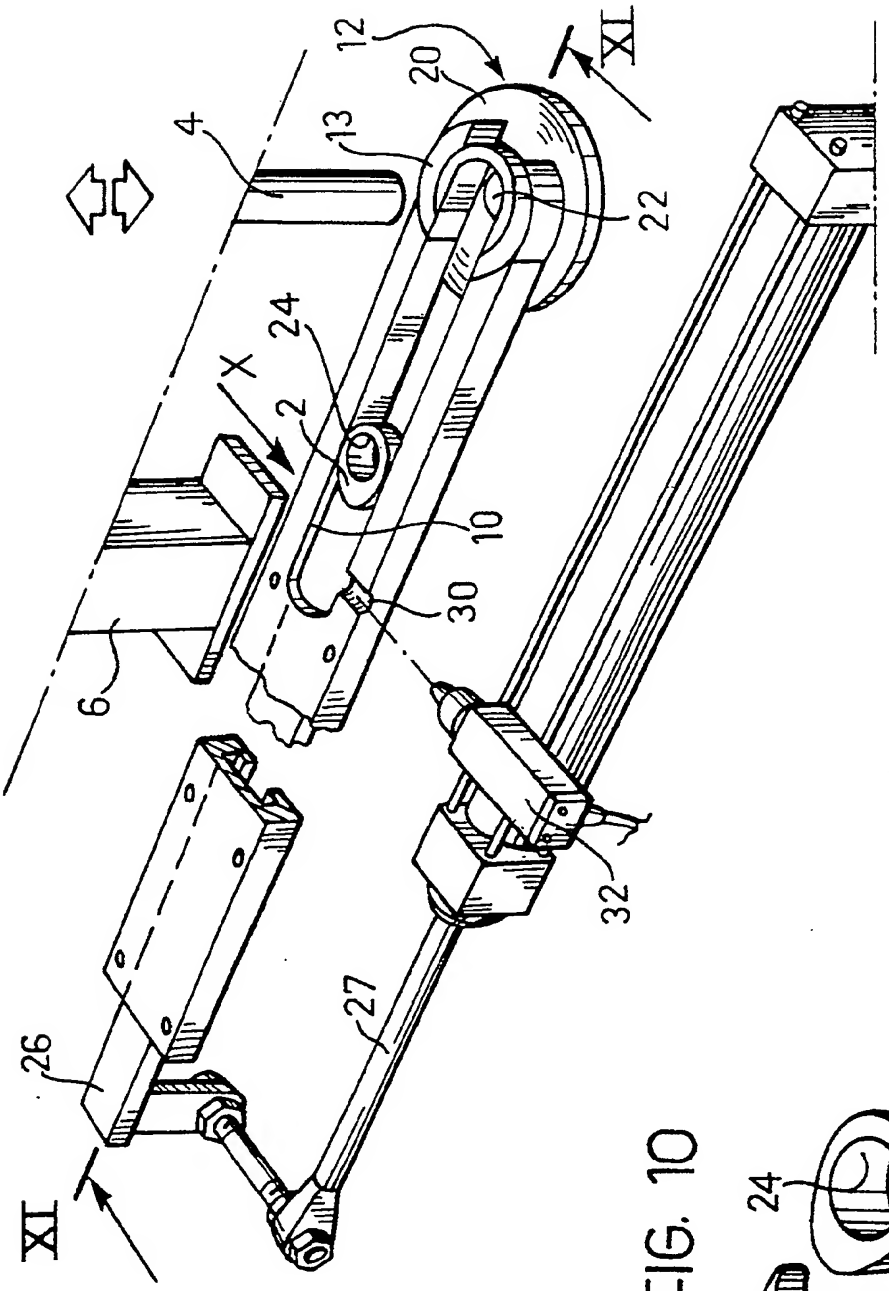
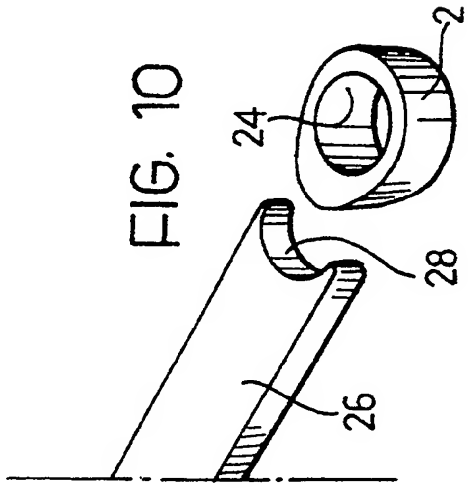


FIG. 10



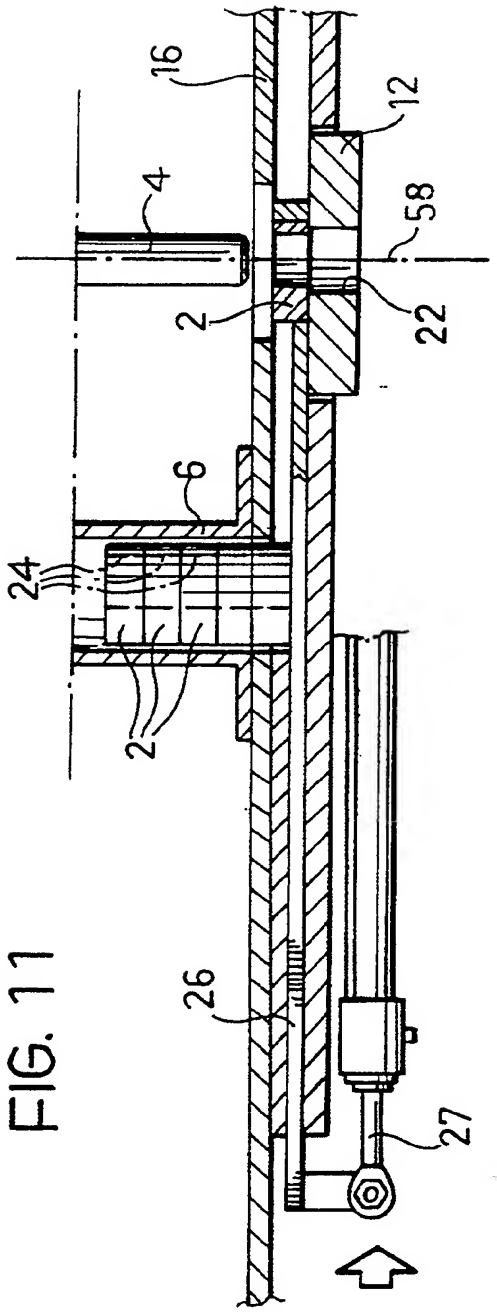


FIG. 11

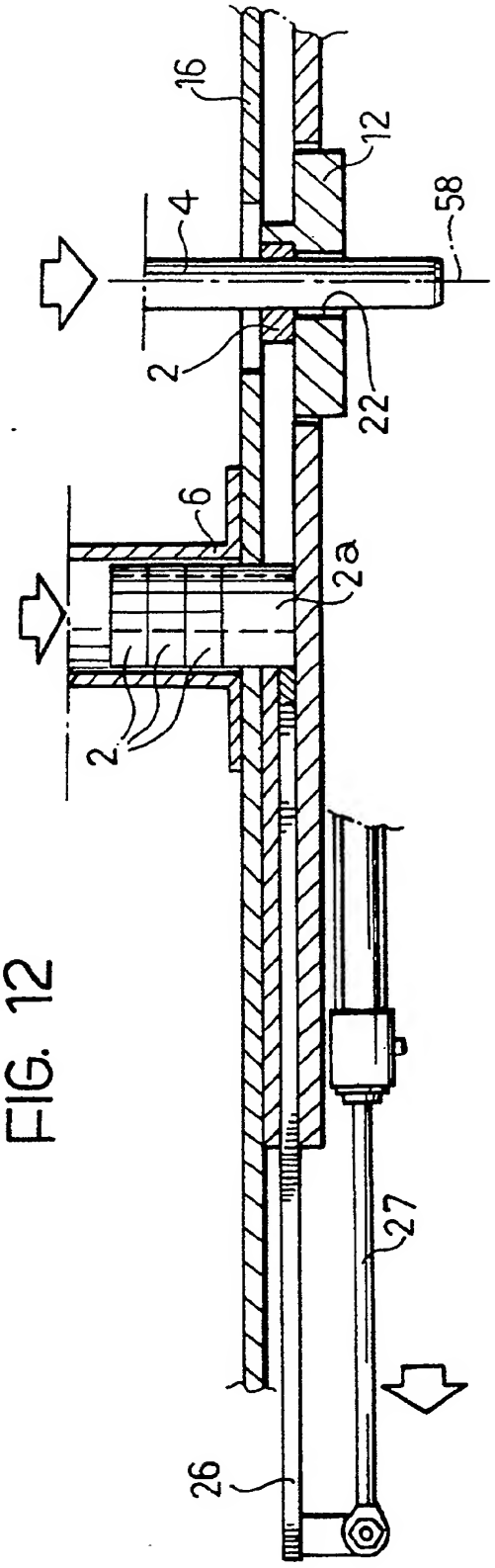


FIG. 12

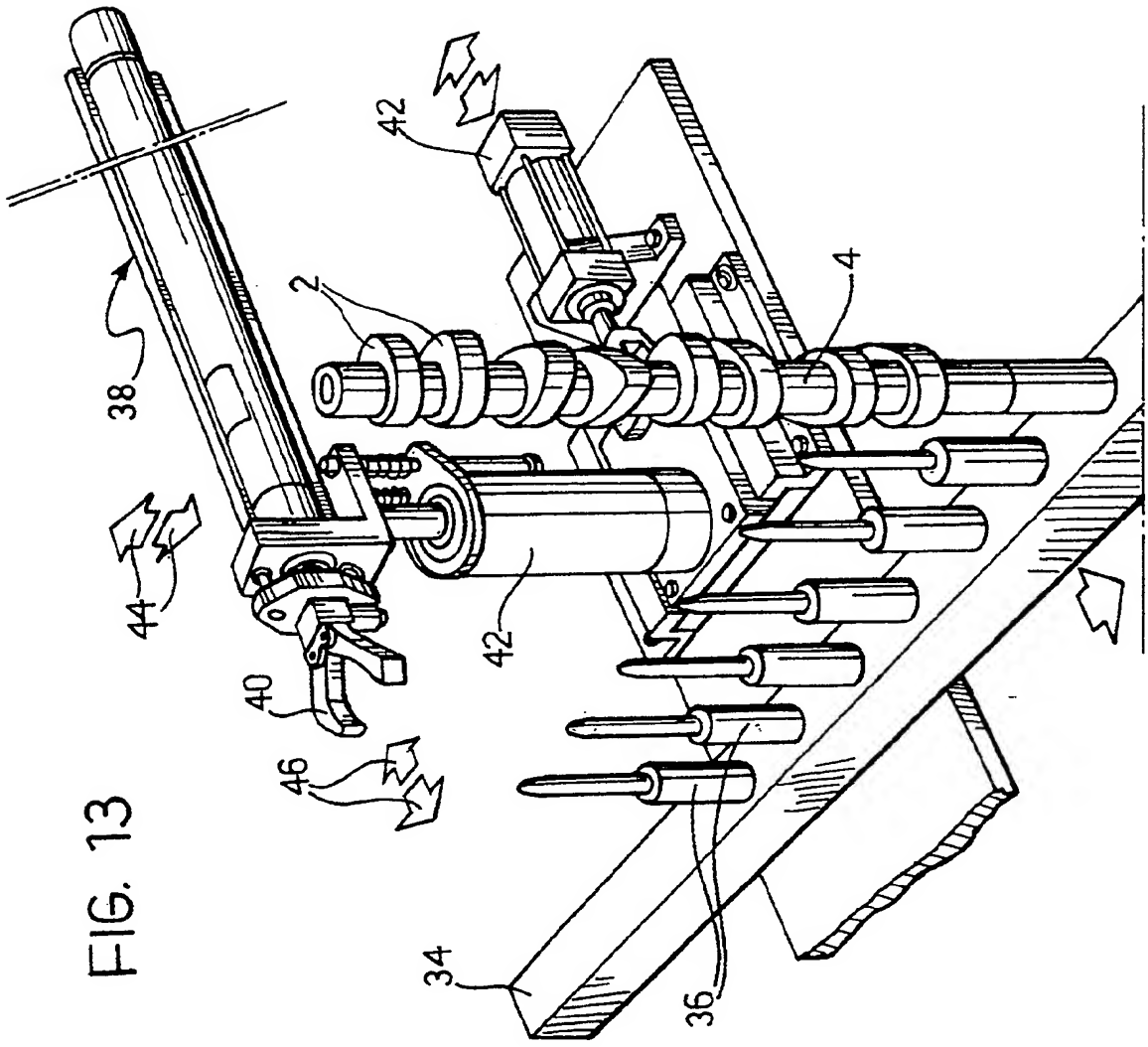


FIG. 13

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 83 0255

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	DE-A-2 838 995 (TOYOTA) * page 10, line 11 - page 12, line 11 *	1,8,12	B23P19/02
A	GB-A-2 156 937 (GKN BOUND BROOK) * page 2, line 56 - line 71 *	11	
A	DE-C-257 247 (WILHELM TAFEL) * figures *	3	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B23P
F01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04 SEPTEMBER 1991	RIS M.

CATEGORY OF CITED DOCUMENTS

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E : earlier patent document, but published on, or after the filing date
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